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(54) Electrically-operated mirror angle adjusting device.

(57) The mirror (1) is pivotally connected to an actuator unit housing (3) containing two actuators. Two adjusting nuts each having a movable pivot (10, 11) are respectively movable by their actuators so as to adjust the angle of the mirror (1). The device of the invention is characterized by having a first guide means and/or a second guide means for controlling the direction of inclination, horizontal or vertical, of the mirror (1) so as to prevent the mirror from being obliquely displaced during the operation of the motor vehicle. The first guide means comprises a cruciform member (28) provided on the actuator unit housing (3) and a cruciform groove engaging therewith, provided on a mirror holder. The second guide means comprises openings (25), longer in the horizontal or vertical direction, into which the adjusting nuts are respectively inserted.

EP 0 059 073 A1

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ELECTRICALLY OPERATED MIRROR ANGLE ADJUSTING DEVICE

This invention relates to an electrically operated mirror angle adjusting device for a mirror mounted on a door, a fender or the like, of a motor vehicle.

Devices adapted to control remotely the angle of reflection of a rear-view mirror by means of two actuators are disclosed, for instance, in U.S. Patents No. 3,609,014 and No. 3,972,597. Each of these devices comprises a supporting pivot for the mirror disposed in the centre of an actuator unit housing, and two movable pivots therefor spaced from said supporting pivot and being located respectively on a horizontal axis and a vertical axis, said movable pivots being movable back and forth by their actuators so as to adjust the horizontal angle and vertical angle of the mirror. Although the centre of a spherical bearing for each of said movable pivots actually moves along a circular arc having its centre at the central supporting pivot, each of said movable pivots is adapted to move along a straight line because it is fixed to the output shaft of its actuator or to an externally-threaded rod engaging with the central hole of a worm wheel of the actuator. Therefore, the movable pivots do not follow the movements of their spherical bearings, and smooth operation is not obtained. Furthermore, at the time of assembly, the pivots may not be accurately fitted in their proper positions.

In U.S. Patent Application Serial No. 06/077,390, there is disclosed an electric mirror angle adjusting device comprising a pair of pivot screws each being pivotally attached within the central hole of a worm wheel of an actuator, an adjusting nut with a plurality of catches engaging with each pivot screw, and a movable pivot being provided at one end of each adjusting nut, so that each movable pivot not only moves back and forth but also swings conically on the base of its pivot screw

as its spherical bearing moves along a circular arc. Therefore, in this device, the angular adjustment of the mirror can be made smoothly, and assembly work is facilitated.

Since each movable pivot is adapted to swing conically on the root of its pivot screw as mentioned above, this device has, at the same time, the disadvantage that the mirror is not firmly held at its adjusted angle and therefore it may be obliquely displaced by the vibration of the motor vehicle.

It is therefore an object of this invention to provide an electric mirror angle adjusting device which firmly holds the mirror at its adjusted angle so as to prevent it from being obliquely displaced by vibration or the like, without losing the advantage of the aforesaid device, that is, without losing the flexibility of the movement of the movable pivots.

According to the present invention there is provided an electric mirror angle adjusting device comprising an actuator unit housing containing an actuator unit including two actuators, a mirror holder pivotally connected adjacent its central portion to said actuator housing, two adjustment members each having a movable pivot, said adjusting members being respectively movable by said actuators so as to adjust the horizontal and vertical angles of a mirror, characterised in that there is provided guide means for controlling the direction of horizontal and/or vertical inclination of said mirror.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings in which:-

Fig. 1 is a partially cutaway front view of a first embodiment of an electrically operated mirror angle adjusting device according to the present invention;

Fig. 2 is a transverse sectional view of the device of Fig. 1;

Fig. 3 is a vertical sectional view of the device of Fig. 1;

Fig. 4 is a front view of an actuator unit housing, the cover portion of which is partially cut away.

Fig. 5 is an enlarged sectional view taken on line V-V of Fig. 4.

Fig. 6 is an enlarged sectional view taken on line VI-VI of Fig. 4.

Fig. 7 is a rear view of a mirror holder.

Fig. 8 is an enlarged sectional view showing a portion of an actuator unit.

Fig. 9 is an enlarged sectional view showing a portion of an actuator unit including a modified adjusting nut.

Fig. 10 is a perspective view showing said modified adjusting nut.

Fig. 11 is a partially cutaway side view of a second embodiment of an electrically-operated mirror angle adjusting device according to the invention;

Fig. 12 is a front view of the mirror of Fig. 11, the central portion of which is cut away to show an actuator unit housing;

Fig. 13 is a partially cutaway front view of the actuator unit housing of Fig. 12;

Fig. 14 is a perspective view of the actuator unit housing of Figs. 12 and 13;

Fig. 15 is an enlarged sectional view showing a portion of the actuator unit of Figs. 12 to 14;

Fig. 16 is a perspective view of an adjusting nut having fins for use in the actuator unit as illustrated in Fig. 15;

Fig. 17 is a perspective view of a third embodiment of the present invention showing an actuator unit and a mirror holder separated from each other symmetrically;

Fig. 18 is a front view showing the mountings of a cross pin used in the arrangement of Fig. 17;

Fig. 19 is a side view of the cross pin arrangement of Fig. 18;

Fig. 20 is a front view showing how the end of said cross pin of Figs. 17 to 19 is inserted into a bearing;

Fig. 21 is a side view of a fourth embodiment of the present invention;

Fig. 22 is a front view showing an actuator unit housing used in the arrangement of Fig. 21 and

Fig. 23 is a diagram showing an example of a driving circuit for an electric motor.

Referring to the drawings, Figs. 1 to 8 illustrate a first embodiment of an electrically-operated mirror adjusting device which includes both a first guide means comprising a cruciform member provided on the front face of an actuator unit housing and a cruciform groove, engageable therewith, provided on a mirror holder, and second guide means comprising openings, longer in the horizontal or vertical direction, into which adjusting nuts with movable pivots are respectively inserted. In the second embodiment shown in Figs. 11 to 16, there is included only the first guide means comprising the cruciform member and the cruciform groove, and the second guide means is not included. The third embodiment shown in Figs. 17 to 20 is similar to the embodiment of Figs. 11 to 16 but uses a cross pin in place of the cruciform member. The fourth embodiment shown in Figs. 21 and 22 includes only the second guide means comprising the long openings, and does not include the first guide means.

Referring to Figs. 1 to 8 of the drawings, a mirror 1 is mounted in a mirror holder 2. An actuator unit housing 3 contains two actuators and consists of a base portion 12 and a cover portion 13. A flexible seal 4 of a bellows type is disposed between the mirror holder 2 and the sides of the actuator unit housing 3. A cable or harness 5 extends outward from the actuator unit housing 3. A first guide

means 6 for controlling the direction of inclination of the mirror 1 comprises, as described in detail below, a cruciform member on the front of the actuator unit housing 3 and a cruciform groove on the mirror holder 2. A spherical bearing 7 is provided in the centre of the cruciform member on the front of the actuator unit housing 3 and a stationary supporting pivot 8 is provided in the centre of the cruciform groove on the mirror holder 2. Two adjusting nuts 9 are located some distance away from the supporting pivot 8 on a horizontal axis and a vertical axis respectively which meet at right angles to each other at the supporting pivot 8. A movable pivot 10 is provided on the end of the adjusting nut 9 on said horizontal axis and another movable pivot 11 is provided on the end of the other adjusting nut 9 on said vertical axis. A mirror body 14 contains the actuator unit housing 3 and the mirror 1. The mirror 1 is supported on the three pivots, that is, the stationary central supporting pivot 8 and the two movable pivots 10, 11. Each of the adjusting nuts 9 with the movable pivots 10, 11 is adapted to be moved back and forth by each of the actuators so as to adjust the horizontal or vertical angle of the mirror 1.

The actuator unit housing 3, consisting of the base portion 12 and the cover portion 13, is realtively thin and is secured within the mirror body 14 with its base portion 12 held by means of a fastening member 15. A groove 20 is provided along the edges of the cover portion 13, and a groove 20a of the same shape is provided on the back side of the mirror holder 2, whereby the flexible sealing cover 4 can be securely located by means of these grooves. The base portion 12 is fixed to the cover portion 13 by means of internally screw-threaded holes 21 in the base portion 12 into which screws 22 can be inserted. A worm 23 fixed to the output shaft of an electric motor, meshes with a worm wheel 24 which defines an opening 25 into which the adjusting nut 9

is inserted. A sperical bearing 26 is provided on the mirror holder 2 and into which bearing 26 the movable pivot 10 can be fitted. A sperical bearing 27 is similarly provided to receive the movable pivot 11.

Reference will now be made to guide means for controlling the direction of inclination of the mirror 1. The first guide means 6, as previously stated comprises a cruciform member and a cruciform groove, and the second guide means comprises openings, longer in the horizontal or vertical direction, into which the adjusting nuts 9 are respectively inserted.

The guide means 6 comprises a cruciform member 28 provided on front of the cover portion 13 of the actuator unit housing 3 as shown in Figs. 1 and 6, and a cruciform groove 29 provided on the rear face of the mirror holder 2 as shown in Fig. 7, said cruciform member 28 being engageable with said cruciform groove 29 as shown in Fig. 5. The cruciform member 28 is provided at each of its ends with a leg 44 as shown in Figs. 5 and 6. The legs 44 space the cruciform member 28 and the spherical bearing 7 at its centre away from the front face of the actuator unit housing 3, and consequently the mirror 1 is spaced therefrom. The cruciform groove 29 (Fig. 7) comprises four members 43 each having a shape that in general resembles the letter "L" (hereinafter referred to as "L-shaped member", the L-shaped members 43 being disposed at spaced intervals around the central supporting pivot 8 of the mirror holder 2 so as to face one another. Four inside corners of these L-shaped members 43 constitute abutment members which support the outer surface of the spherical bearing 7 of the actuator unit housing 3. That is, as shown in Fig. 5, the inner surface of the spherical bearing 7 supports the stationary supporting pivot 8 of the mirror holder 2, and at the same time the outer surface thereof is supported by said inside corners of the L-shaped members 43. Since the mirror 1 is supported on the three pivots, that is, the stationary

supporting pivot 8 and the two movable pivots 10,11 and the cruciform member 28 is engaged within the cruciform groove 29, the direction of inclination, both horizontal and vertical, of the mirror 1 is properly controlled so as to ensure accurate angular adjustment of the mirror 1. Furthermore, even when the mirror 1 is subjected to vibration during the operation of the motor vehicle, the adjusted horizontal or vertical angle of the mirror 1 is maintained, and the mirror 1 is prevented from turning on the supporting pivot 8, that is, from being obliquely displaced.

The second guide means comprises two elongated openings 25 into which the adjusting nuts 9 are respectively inserted. As shown in Fig. 1, the two openings 25 extend through the cover portion 13 of the actuator unit housing 3, at a distance spaced from the spherical bearing 7, the openings 25 being located respectively on the intersecting horizontal and vertical axes, the opening 25 on said horizontal axis being longer in the horizontal direction, and the other opening 25 on said vertical axis being longer in the vertical direction. The adjusting nuts 9, when inserted into these elongated openings 25 are guided thereby as follows: When the adjusting nut 9 with its movable pivot 10 is inserted into the elongated opening 25 having its longer dimension in the horizontal direction and said nut 9 is moved back or forth but its actuator, it is guided so as to tilt in the horizontal direction according to the angle of inclination of the mirror 1. When the adjusting nut 9 with its movable pivot 11 inserted into its vertical opening 25 is moved back or forth by its actuator, it is guided so as to tilt in the vertical direction according to the angle of inclination of the mirror 1. The adjusting nuts 9 are not allowed to move or tilt in the direction at right angles to said respective directions.

When both the first guide means and the second guide

means are employed, the direction of inclination of the mirror 1 is controlled very effectively.

Reference will now be made to an actuator unit for actuating the movable pivots 10 and 11. The actuator unit comprises two small electric motors 31, 32 arranged within the actuator unit housing 3, a worm 23 being fixed to the output shaft of each electric motor 31 or 32. Two pivot screws 48 are each disposed within the central hole of the worm wheel 24 of each of two worm mechanisms 30 so as to be in mechanical engagement therewith, and the two adjusting nuts 9 each provided at its upper end with the movable pivot 10 or 11 and at its lower end with catches 54 in operative engagement with screw thread 52 of each pivot screw 48. The actuator unit housing 3 consists of the hollow base portion 12 and the hollow cover portion 13, and has a shape which in general resembles a hollow drum. Therefore, if the electric motors 31, 32 are mounted directly in the actuator unit housing 3, the vibrations of the electric motors 31, 32 and the worm mechanisms 30 are magnified by the actuator unit housing 3, and give rise to undesirable resonance. Thus, according to the present invention, each of the electric motors 31, 32 is provided at its each end with a virbration-absorbing member 42 of an annular shape which is in contact with projecting portions 61 on the inside of the actuator unit housing 3, said vibration-absorbing members 42 absorbing the vibrations of the electric motors 31, 32 caused by their rotation thereby preventing said resonance (See Fig. 6).

Fig. 8 shows, in detail, an assembly of the pivot screw 48 and the adjusting nut 9 within one of the worm wheels 24. It is to be noted that Fig. 8 is an enlarged sectional view showing the adjusting nut 9 for horizontal adjustment moved forward out of opening 25 from the position shown in Fig. 5. The worm wheel 24 is rotatably supported within annular projections 45 and 46 (Figs. 8 and 9) provided on opposed inner surfaces of the cover

portion 13 and the base portion 12 respectively of the actuator unit housing 3. The cylindrical hub of the worm wheel 24 forms a central hole 47, within which the pivot screw 48 is pivotally disposed in mechanical engagement therewith. A semi-spherical projection 50 serving as a pivot is provided centrally of the annular projection 46 on the inner surface of the base portion 12, and a concavity corresponding to the semi-spherical projection 50 is formed centrally on the outwardly and upwardly inclined lower surface of a base portion 49 of the pivot screw 48, said semi-spherical projection 50 being fitted within said concavity. A convex surface 51 is formed on the circumference of the base portion 49 of the pivot screw 48, and a concave surface 53 conforming to the convex surface 51 is formed along the lower inside of the worm wheel 24, said convex surface 51 and concave surface 53 each being provided with interlocking projections and recesses so that the pivot screw 48 is mechanically connected with the worm wheel 24 and rotatable thereby without slipping. Since the pivot screw 48 is mounted on the semi-spherical projection 50 which serves as a pivot, the pivot screw 48 and the adjusting nut 9 can tilt as the spherical bearing 26(27) moves along a circular arc when the mirror 1 is angularly adjusted.

Each adjusting nut 9 is provided in its lower portion with a plurality (three as shown in the drawings) of catches 54 each of which engages in the screw thread 52 of the pivot screw 48. The movable pivot 10 or 11 on top of each adjusting nut 9 is provided with a small projection 64 which is inserted into a slit 57 in the spherical bearing 26 or 27 of the mirror holder 2 so as to prevent rotation relative thereto (See Fig. 8). Therefore, when one of the pivot screws 48 is rotated in either direction through the worm mechanism 30 by the electric motor 31 or 32, one of the adjusting nuts 9 moves forward or backward out of or into its opening 25 and thereby the angle of inclination of

the mirror 1 is changed within certain limits.

Each adjusting nut 9 is provided in its centre with a pin 58 which can be inserted into a central hole 59 of the pivot screw 48. In assembling the rear-view mirror, each adjusting nut 9 is attached as follows: Firstly, the worm wheel 24 and the pivot screw 48 are located in position in the base portion 12, and the cover portion 13 is fixed onto the base portion 12 by means of the screws 22. Then, the adjusting nut 9 is inserted into the opening 25 of the cover portion 13, and its catches 54 are engaged with the screw thread 52 of the pivot screw 48. Before the adjusting nut 9 is attached, however, the pivot screw 48 does not necessarily stand erect on the base portion 12 due to the fact that it is merely located on the semi-spherical projection 50. Furthermore, even if the pivot screw 48 does stand erect at that time, it is easily tilted even by a slight contact with the catches 54 of the adjusting nut 9. Therefore, it is difficult to engage the catches 54 properly with the threaded portion 52 of the pivot screw 48. According to this embodiment, however, the pin 58 provided in the centre of the adjusting nut 9 facilitates the aforesaid assembly work, because the end of the pin 58 is inserted into the central hole 59 of the pivot screw 48 and automatically aligns the pivot screw 48 with the adjusting nut 9 before the catches 54 come into contact with the screw thread 52 of the pivot screw 48.

Fig. 23 shows an example of a driving circuit for the electric motors 31 and 32. The circuit includes a battery 33 as a power source, a mirror switch provided on the instrument panel or the like of the motor vehicle, a changeover switch 35, 36 for horizontal adjustment, a changeover switch 37, 38 for vertical adjustment, a changeover switch 39 for switching between a right-hand mirror 40 and a left-hand mirror 41. Each of the switches 35 to 38 comprise a movable contact provided on a control knob (not shown) and a fixed contact disposed on a printed

circuit (not shown). The changeover switch 39 may be contained in the knob so as to move back and forth, or it may be an independent changeover switch disposed beside the knob. By means of these changeover switches, it is possible to choose which of the right-hand mirror 40 and the left-hand mirror 41 is to be operated, and then adjust its angle horizontally and/or vertically in a desired manner by rotating the electric motor or motors in either direction.

As shown in Figs. 1 to 3, the mirror body 14 of this embodiment is made thin so that it is less liable to collide again after being folded inward by a first collision. The actuator unit housing 3 is fixed by means of screws to the fastening member 15 within the mirror body 14. The fastening member 15 is provided on its upper portion with a retaining poriton 71 having a flange, to which one end of a coiled spring 70 is fastened, the other end thereof being fastened through the intermediary of a link 76 to a bracket 77 on a stay 72. The mirror body 14 is connected to the stay 72 by a double-action link 73 having two hinges 74 and 75.

The operation of the electric mirror angle adjusting device of the invention will now be described.

To use the device, it is necessary, first of all, to choose which of the right-hand mirror 40 and the left-hand mirror 41 is to be angularly adjusted, and manipulate the changeover switch 39 according thereto. If, for example, the changeover switch 39 is switched to the right side (R side) as shown in Fig. 23 and the changeover switches 37, 38 for vertical adjustment are pushed upward, the electric motor 32 for the right-hand mirror 40 is energized and starts rotating in the normal direction. Then, the electric motor 32 rotates its worm 23 and the associated worm wheel 24 as shown best in Fig. 4, and the worm wheel 24 rotates the pivot screw 48 which is in engagement therewith. On rotation of the pivot screw 48, the adjusting nut 9 with its movable pivot

11 for vertical adjustment is moved forward out of its opening 25 because its catches 54 are in engagement with the screw-thread 52 of the pivot screw 48. On the forward movement of the movable pivot 11, the right-hand mirror 40 is pivoted about its supporting pivot 8 and thus its vertical angle is adjusted. When the desired angle of the right-hand mirror 40 is obtained, the changeover switches 37, 38 are returned to their neutral positions. If the changeover switches 37, 38 are pushed downward, the electric motor 32 rotates in the reverse direction and moves the adjusting nut 9 backward into its opening 25 so as to adjust the right-hand mirror 40 in the opposite direction. In order to make horizontal adjustment of the right-hand mirror 40, the changeover switches 37, 38 are kept in neutral and the changeover switches 35, 36 are pushed to the right or left in Fig. 23 to rotate the electric motor 31 in the normal or reverse direction. Then, the adjusting nut 9 with its movable pivot 10 for horizontal adjustment is moved forward or backward in the same way as described above so as to effect horizontal adjustment of the right-hand mirror 40. In order to effect the horizontal or vertical adjustment of the left-hand mirror 41, the changeover switch 39 is switched to the left side (L side) in Fig. 23 and then the same procedures as above are carried out.

Apart from the automatic adjustment described above, it is also possible to adjust manually the angle of each mirror. If the front face of the mirror is pushed by hand at a position away from the supporting pivot 8, the catches 54 of the adjusting nut 9 are pivoted out of engagement with the screw thread 52 of the pivot screw 48 by the applied manual force so that they can move forward or backward along the screw thread 52 of the pivot screw 48. Thus, the adjusting nut 9 moves forward or backward and pivots the mirror about its supporting pivot 8.

Fig. 10 shows a modified example of the adjusting nut 9.

In this example, the adjusting nut 9 is provided adjacent the roots of its catches 54 with a plurality (two in Fig. 10) of projections 65 which extend outward beyond the perimeter of the opening 25 so as to prevent the adjusting nut 9 from coming out of the opening 25. When the mirror 1 is detached from the actuator unit housing 3 for the readjustment of the mirror setting, the adjusting nut 9 without such projections 65 is liable to be pulled away from its pivot screw 48, and therefore it has to be re-engaged with the pivot screw 48. In this modified example, however, even when the mirror 1 is detached from the actuator unit housing 3, the adjusting nut 9 is not disengaged from its pivot screw 48 because the catches 65 contact the inner surface of the opening 25 (See Fig. 9). This feature facilitates the assembly and readjustment of the rear-view mirror.

In Figs. 11 to 14, a second embodiment of the invention is shown which incorporates an actuator unit housing 3 having a shape which is modified in comparison with that of the above-described first embodiment. In the second embodiment, the actuator unit housing 3 is thin and has a shape of a lozenge, the diagonals of which coincide with the aforesaid horizontal and vertical axes, the vertexes of said lozenge being rounded off.

The actuator unit housing 3 is fixed in position by means of holes 16 engageable with the fastening member 15 fixed within the mirror body 14, screw holes 17, and an internally threaded hole 19 into which a setscrew 18 is inserted from below. The base portion 12 and the cover portion 13 of the actuator unit housing 3 are fixed to each other by means of the screws 22 inserted into the internally threaded holes 21 in the same manner as in the embodiment described with reference to Figs. 1 to 8. As in the previous embodiment also, the guide means 6 comprises cross-shaped member 28 provided on the front of the actuator unit housing 3 and cross-shaped groove 29 provided on the mirror body 14.

Each adjusting nut 9 of the present embodiment, unlike that of the previous embodiment, is provided on its sides with a pair of fins 55 as shown in Figs. 15 and 16. Each opening 25 into which each adjusting nut 9 is inserted comprises a circular hole 25a and a pair of U-shaped notches 25b provided along the diameter of the hole 25a. The opening 25 on the aforesaid horizontal axis has its U-shaped notches 25b disposed along the horizontal axis, and the opening 25 on the aforesaid vertical axis has its U-shaped notches 25b disposed along the vertical axis. Each of the U-shaped notches 25b is provided on its top with a fin guide 56 of U-shaped section for guiding each fin 55 of the adjusting nut 9. Since the main body of each adjusting nut 9 is inserted into the circular hole 25a and its fins 55 are loosely guided within the fin guides 56, each adjusting nut 9 smoothly tilts as the spherical bearing 26 or 27 moves along a circular arc during operation. Also, since the fins 55 and the fin guides 56 prevent rotation of the adjusting nuts 9, it is not necessary to provide the small projection 64 on the movable pivots 10, 11 as in the previous embodiment.

In this embodiment, the operation of adjusting the angle of the mirror 1 is the same as in the previous embodiment, that is, it is adjusted by moving the movable pivots 10, 11 forwards or backwards by means of their actuators. Therefore, the operation will not be described further. Since in the present embodiment, the actuator unit housing 3 has a shape of a lozenge whose vertexes are rounded off, the horizontal and vertical adjustments of the mirror 1 can be performed over a wider range than in the previous embodiment. Particularly because the four sides of the lozenge are inclined at an angle of approximately 45 degrees, the actuator unit housing 3 allows the mirror 1 to incline sufficiently in any direction that is a combination of a horizontal direction X - X' or a vertical direction Y - Y' and a direction Z - Z' as indicated in Fig. 14. As a result, the mirror 1 can be inclined three-dimensionally over a much wider range.

Figs. 17 to 20 show a third embodiment of the present invention in which the aforesaid cross-shaped member 28 of the guide means 6 in the second foregoing embodiment is replaced by a cross pin 80 which forms a universal joint. As shown in Fig. 17, one of the two axes (for instance, the horizontal axis) of the cross pin 80 is supported by a pair of bearings 81 disposed in corresponding positions on the cover poriton 13 of the actuator unit housing 3, and the other axis (for instance, the vertical axis) thereof is supported by a pair of bearings 82 disposed in corresponding positions on the mirror holder 2. Each end 83 of the cross pin 80 has a smaller diameter than other portions thereof so as to enable insertion into each bearing 81 or 82. Each of the bearings 81 has a hole 84 into which the end 83 of the cross pin 81 is inserted, while each of the bearings 82 is U-shaped, the inside dimension of which corresponds to the outside diameter of the end 83. On the inside of and close to each of the bearings 81, there is a guide 85 having a U-shaped opening which is open toward the front. The movable pivots 10 and 11 are the same as those in the previously described embodiments.

Conventional bearings used for such a prupose comprise a circular hole having a notch, and an axis is forced into the circular hole through the notch. However, if the mirror body or the mirror receives, for example, an impact load, the axis may escape from the bearing through its notch and therefore the mirror holder may become disengaged from the actuator unit housing.

Thus, in the present embodiment, the bearings on the actuator unit housing 3 and the bearings on the mirror holder 2, disposed on respective lines at right angles relative to each other, have the aforesaid constructions, and the cross pin 80 is forcefully pushed into the bearings 81 along the guides 85 by utilizing the elasticity of the bearings 81 as shown in Fig. 20.

Accordingly by virtue of the construction of the present embodiment, even if the mirror body 14 or the mirror 1 receives, for example, an impact load, the mirror holder 2 is not disengaged from the actuator unit housing 3 unless the bearings 81, 82 are damaged.

While the guides 85 are shown in Fig. 17 as being disposed only on the actuator unit housing 3, it is to be noted that they may be disposed also on the mirror holder 2.

Figs. 21 and 22 show a fourth embodiment of the present invention in which the aforesaid first guide means comprising the cross-shaped member 28 and the cross-shaped groove 29 is not used, and the direction of inclination of the mirror 1 is controlled only by the aforesaid second guide means comprising elongated opening 25 into which the adjusting nuts 9 are respectively inserted. A central supporting pivot 62 protrudes from the cover portion 13 of the actuator unit housing 3, and is fitted into a central spherical bearing 63 on the mirror holder 2. The supporting pivot 62, along with the two movable pivots 10, 11, supports the mirror 1. The adjusting nut 9 incorporating the movable pivot 10 and disposed on the aforesaid horizontal axis is inserted into the opening 25 which is longer in the horizontal direction. The adjusting nut 9 incorporating the movable pivot 11 and disposed on the aforesaid vertical axis is inserted into the opening 25 which is longer in the vertical direction. When the adjusting nut 9 on the horizontal or vertical axis is moved forward or backward by its actuator, it is guided by its elongated opening 25 so as to tilt in the horizontal or vertical direction as the spherical bearing 26 or 27 on the mirror holder 2 moves along a circular arc. While the above-described second guide means is much simpler in construction than the first guide means comprising the cross-shaped member 28 and the cross-shaped groove 29, it can properly control the direction of inclination, both horizontal and vertical, of the mirror 1 so as to prevent the mirror 1 from being obliquely displaced.

The present invention affords a number of advantages. For example, the actuator unit housing containing the two actuators is relatively thin so that it can be easily attached within a small and thin rear-view mirror such as a door mirror, and the horizontal and vertical angles of the mirror can be adjusted over a wide range. Also, because the guide means for controlling the direction of inclination of the mirror are provided between the mirror holder and the actuator unit housing, the inclination of the mirror is accurately maintained and the mirror is prevented from being obliquely displaced during the operation of the motor vehicle. Furthermore, because the actuator unit comprises two electric motors and two worm mechanisms respectively in direct engagement therewith, unlike prior art devices whose actuator unit comprises a single electric motor and a solenoid-type clutch, the present invention has the advantage that the angle of the mirror can be adjusted surely and quickly.

As many apparently widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments thereof except as defined in the appended claims.

CLAIMS:

1. An electric mirror angle adjusting device comprising an actuator unit housing (3) containing an actuator unit including two actuators, a mirror holder (2) pivotally connected adjacent its central portion to said actuator housing (3), two adjustment members (9) each having a movable pivot (10,11), said adjusting members (9) being respectively movable by said actuators so as to adjust the horizontal and vertical angles of a mirror (1), characterized in that there is provided guide means (6,25) for controlling the direction of horizontal and/or vertical inclination of said mirror (1).

2. An adjusting device as claimed in claim 1, in which the mirror (1) is movable under the control of said guide means about a central pivot (8) mounted in a spherical bearing (7).

3. An electric mirror angle adjusting device as claimed in Claim 2, wherein said guide means comprises a cruciform member (28) disposed on said actuator unit housing (3), having adjacent its centre said spherical bearing (7) into which said supporting pivot (8) is fitted, said cruciform member (28) extending along the horizontal and vertical axes of said mirror (1) and a cruciform groove (29) provided on said mirror holder (2) so as to engage with said cruciform member (28), the outer surface of said spherical bearing (7) being supported by internal abutment members (43) of said cruciform groove (29).

4. An electric mirror angle adjusting device as claimed in Claim 1 or 2, wherein said guide means comprises a cross pin (80), one of the two axes thereof being supported on said actuator unit housing (3), the other axis thereof being supported on said mirror holder (2).

5. An electric mirror angle adjusting device as claimed in any of claims 1 to 4, in which said guide means includes adjusting members (9) disposed within said actuator unit housing (3), openings (25) into which said adjusting members (9) are respectively inserted, said openings (25) extending through said actuator unit housing (3), one of said openings (25), for horizontal adjustment, being longer in the horizontal direction, the other opening (25) for vertical adjustment being longer in the vertical direction.

6. An electric mirror angle adjusting device as claimed in any of claims 1 to 5, wherein said actuator unit comprises two electric motors (31, 32) located within said actuator unit housing (3), two worm mechanisms (30) respectively driven by said electric motors, two pivot screws (48) respectively disposed within worm wheels (24) in said worm mechanisms (30) so as to engage therewith, and said adjusting members (9) respectively engaging said pivot screws (48).

7. An electric mirror angle adjusting device as claimed in Claim 6, wherein said electric motors (31, 32) are mounted within said actuator unit housing (3) through the intermediary of vibration absorbing members (42) so as to prevent resonating of said actuator unit housing (3) during the operation of said electric motors (31,32).

8. A mirror adjusting device as claimed in Claim 6 or 7, wherein each of said adjusting members (9) is provided at its lower end with a plurality of catch elements (54) for engaging with one of said pivot screws (48).

9. A mirror adjusting device as claimed in any of Claims 5 to 8, in which each adjusting member is provided with projections adapted to extend outward beyond the perimeter of its opening (25) so as to prevent the adjusting member from coming out of its opening (25).

FIG.1

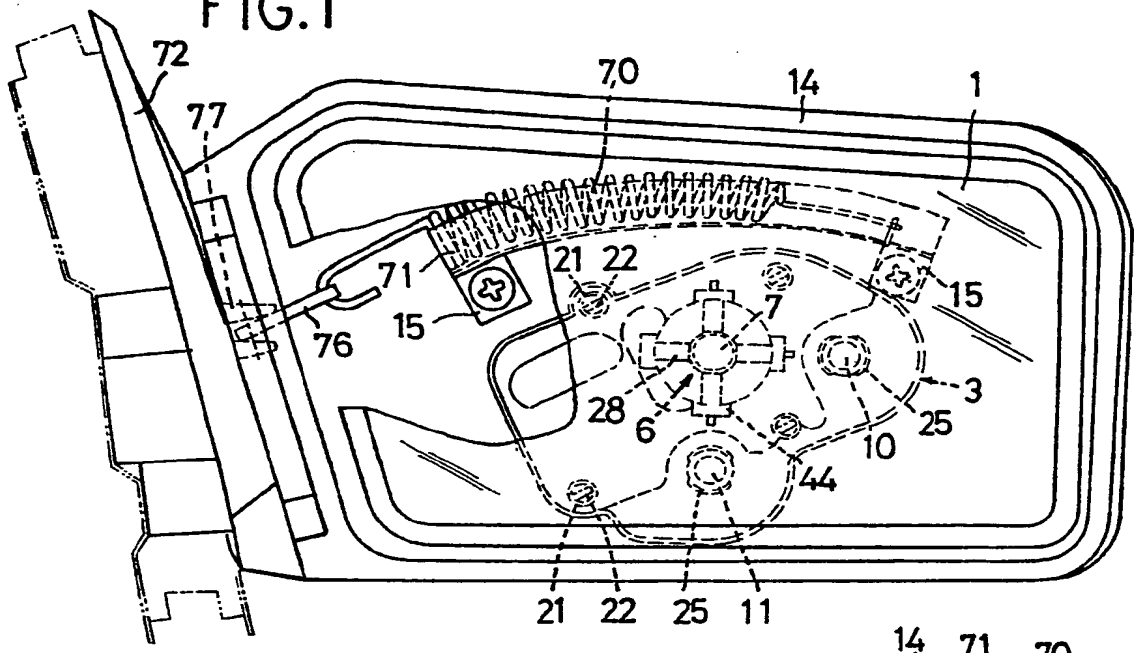


FIG.2

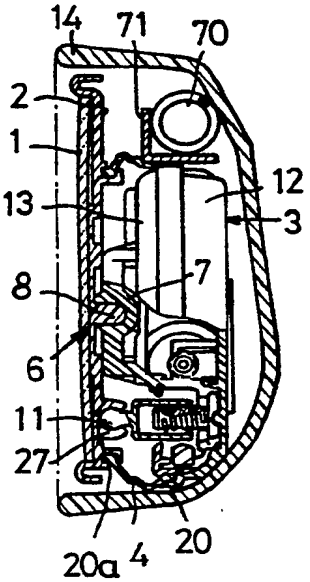


FIG.3

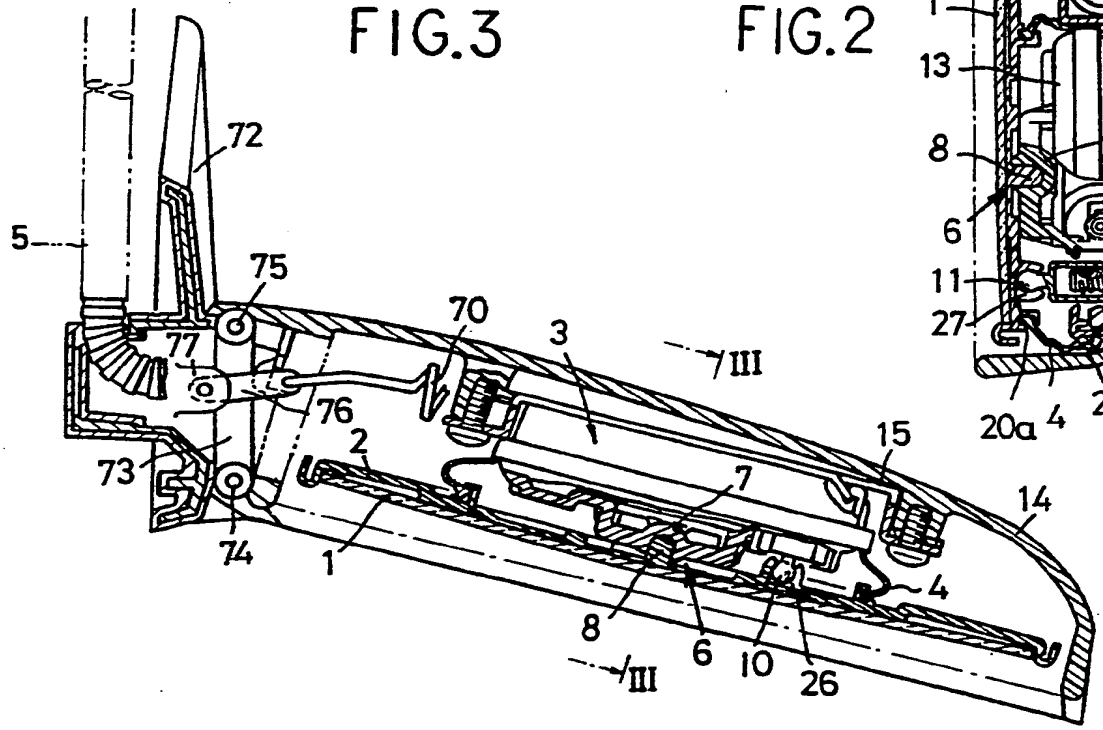
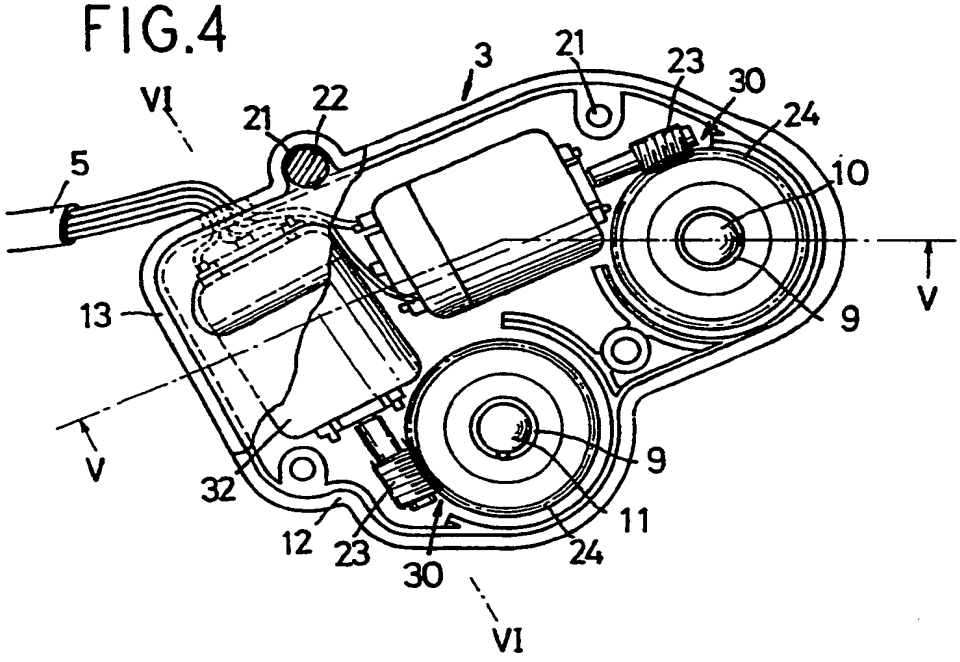


FIG.4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VI

FIG.5

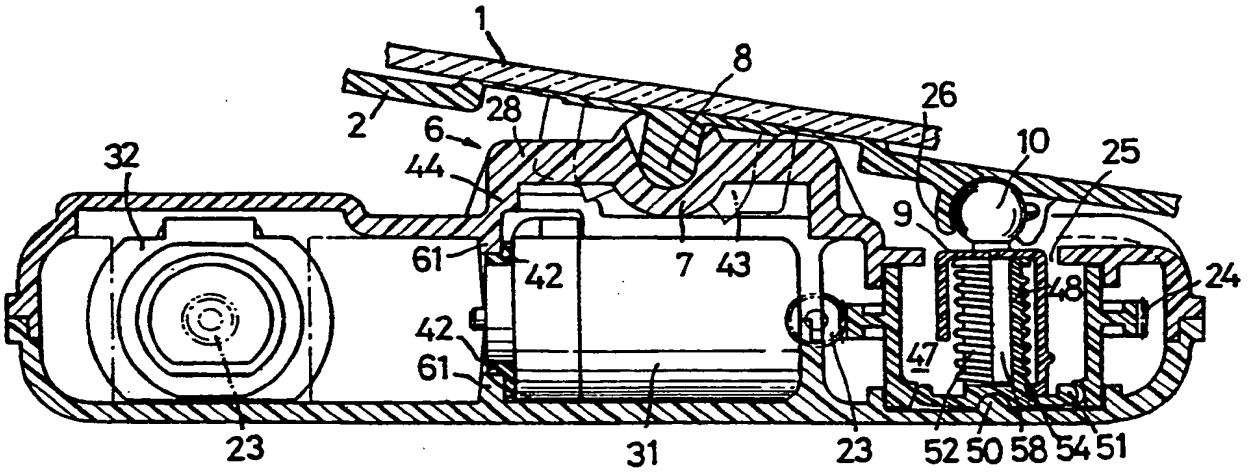
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FIG.6

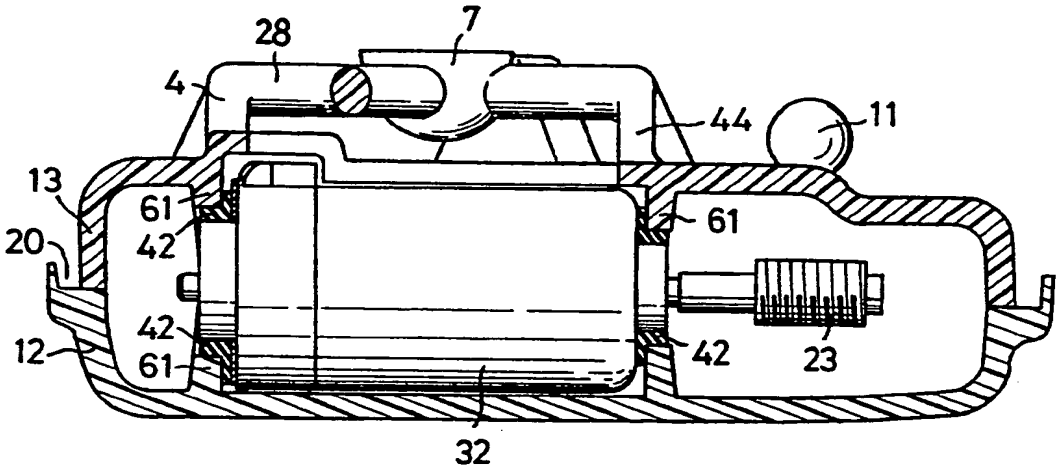


FIG.7

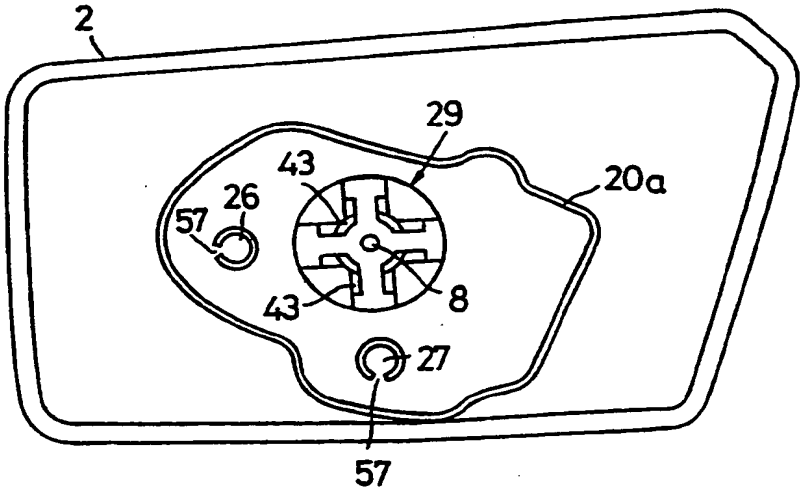


FIG.8

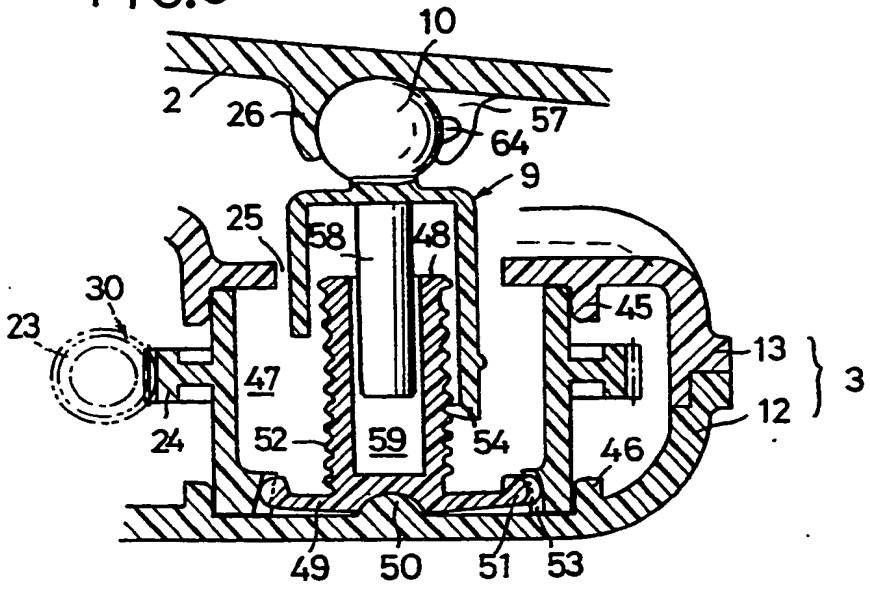


FIG.9

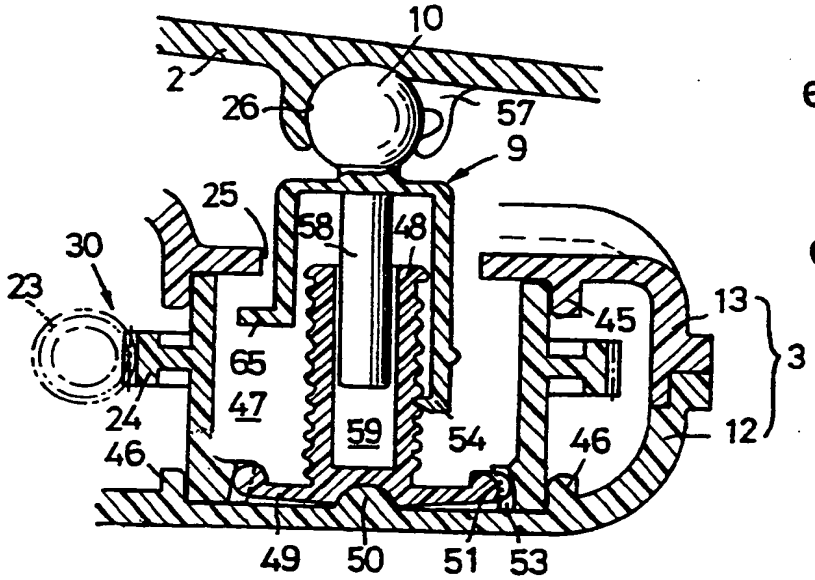


FIG.10

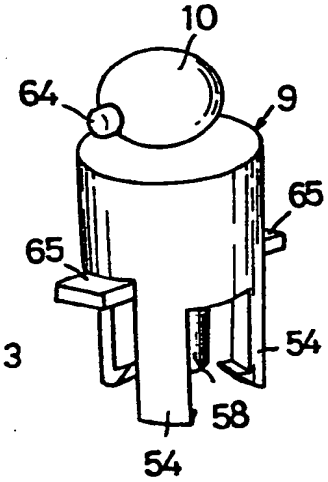
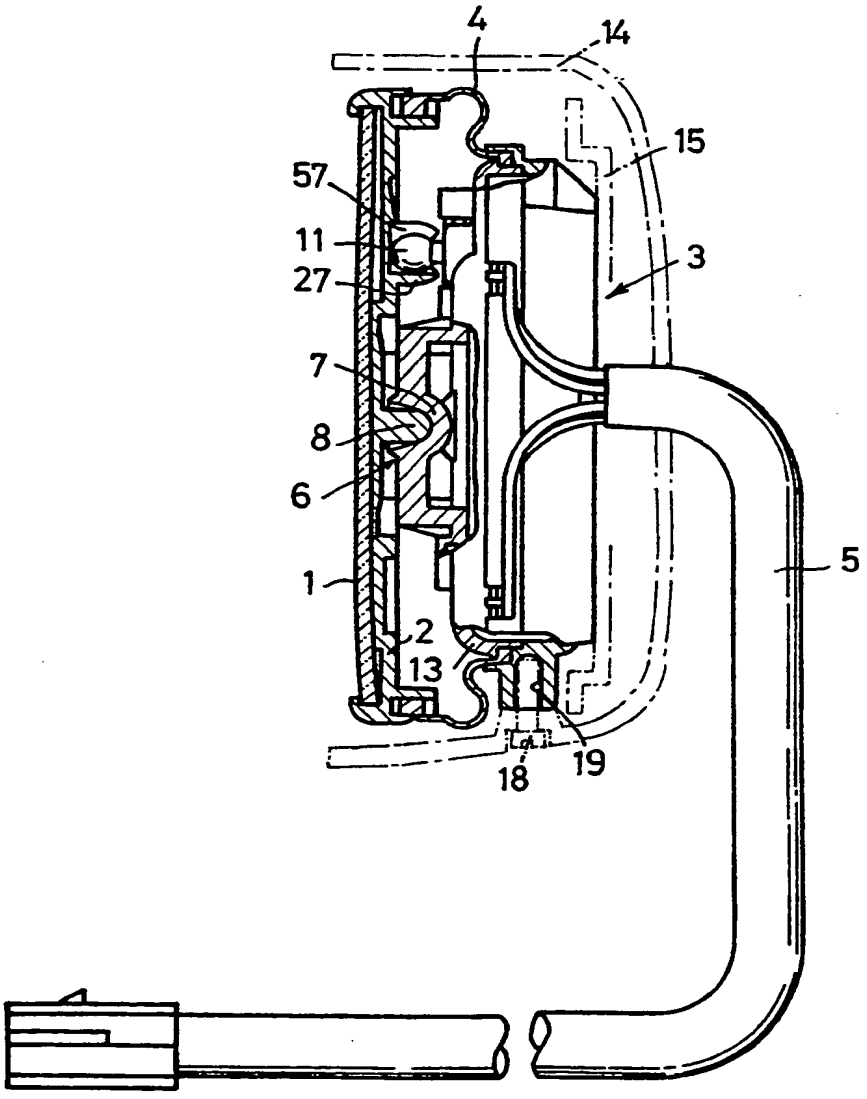
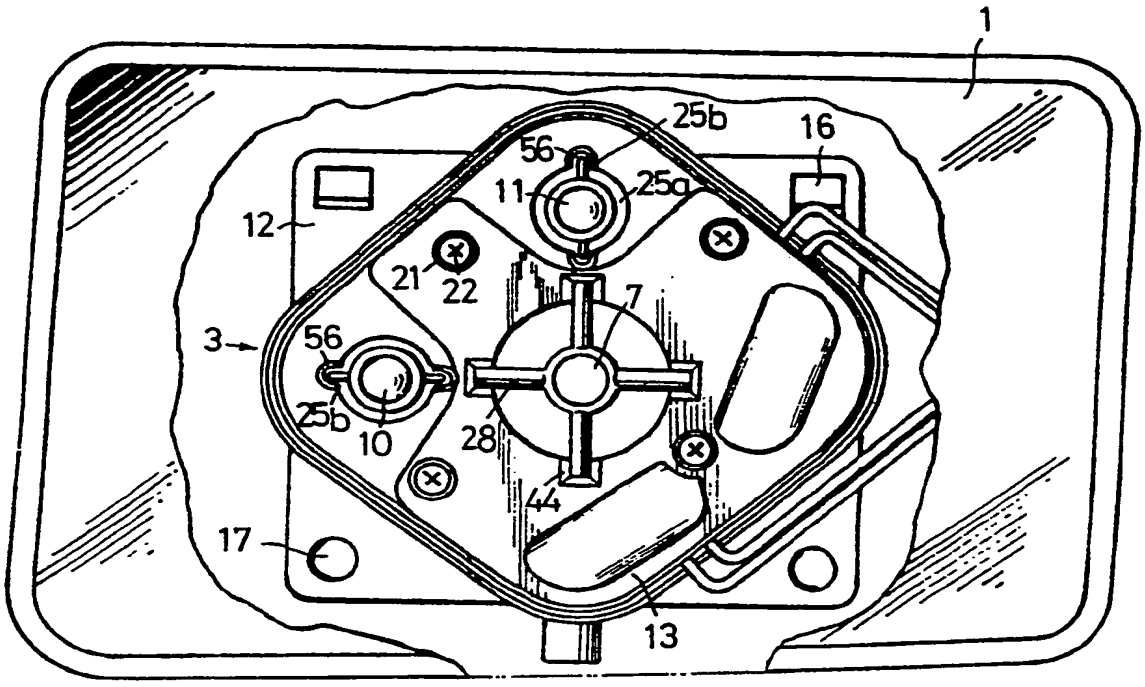


FIG.11

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25b
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25b
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FIG.12

FIG.13

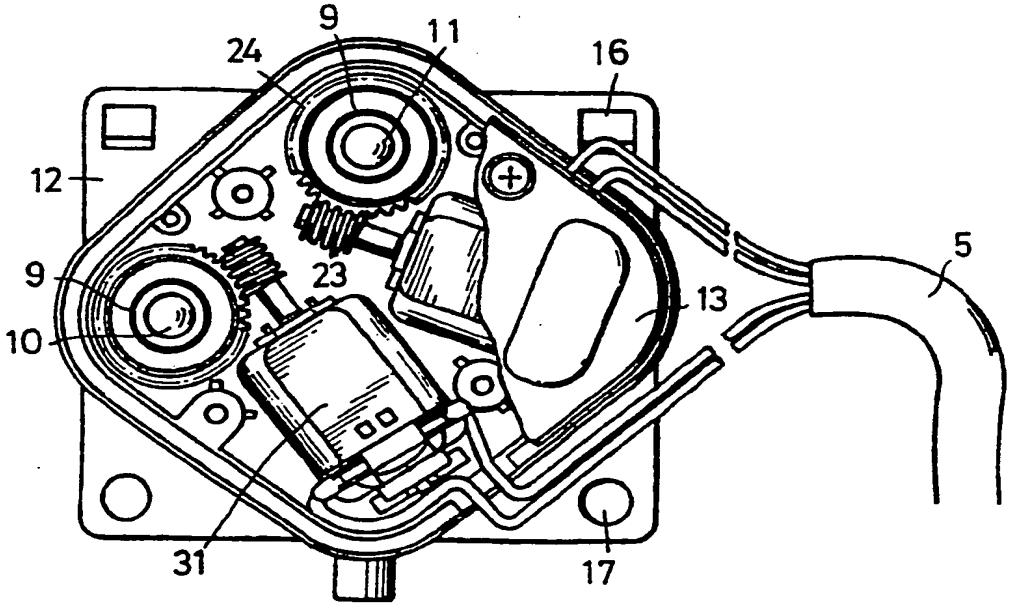
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FIG.14

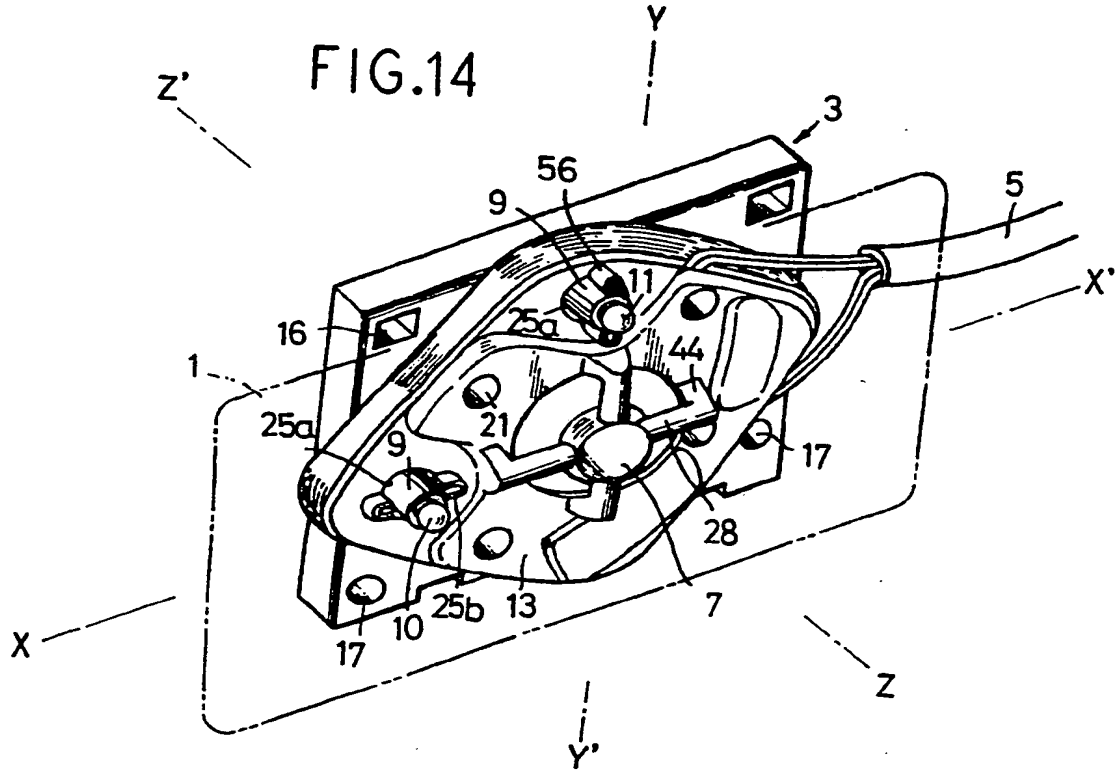


FIG.15

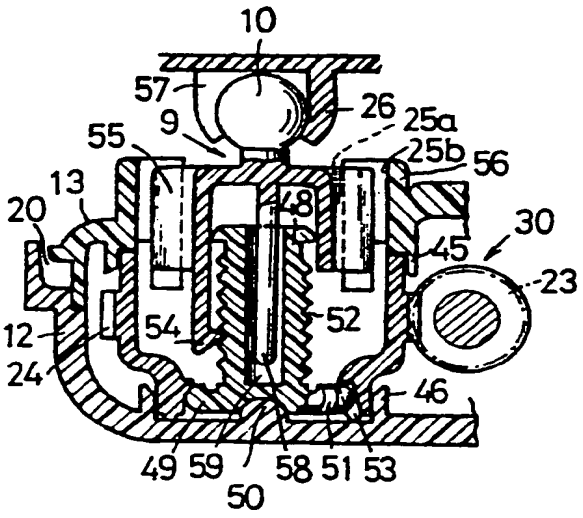


FIG.16

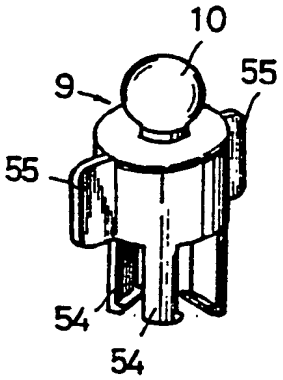


FIG.17

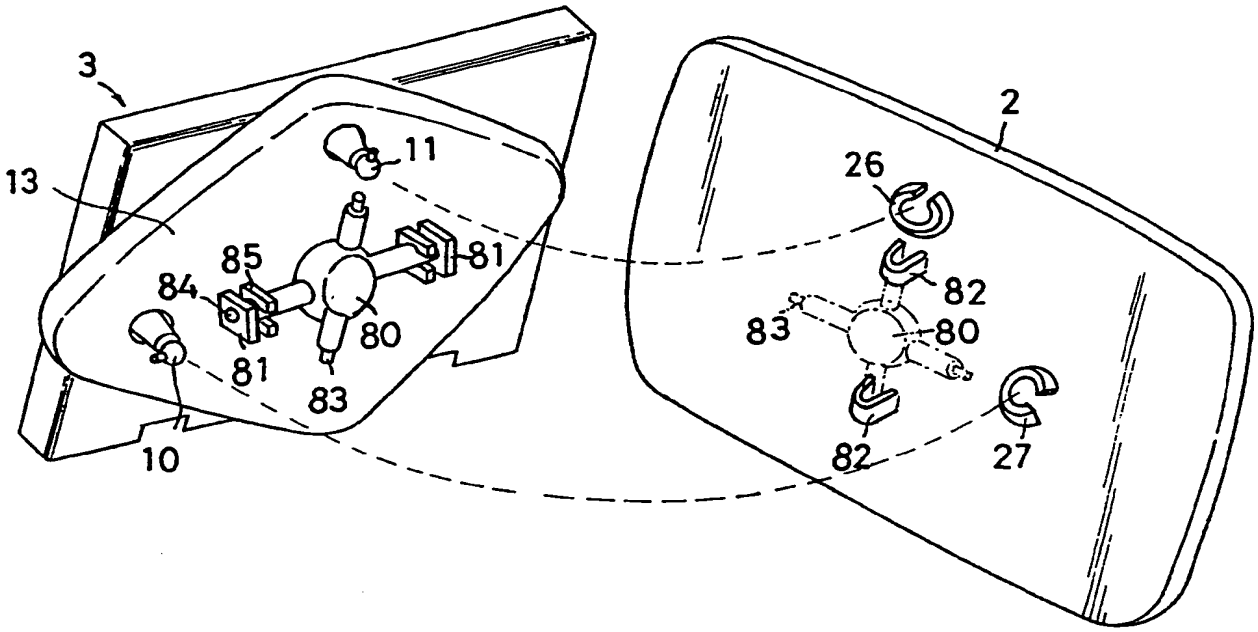


FIG.18

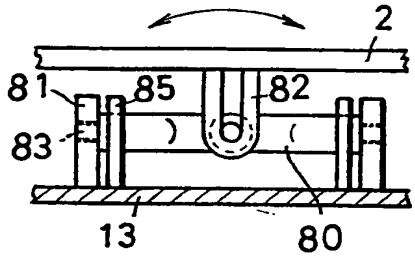


FIG.19

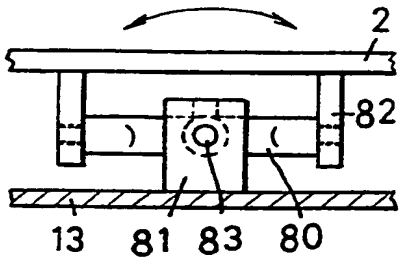


FIG.20

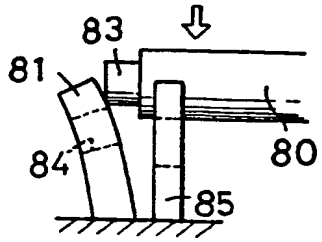


FIG.21

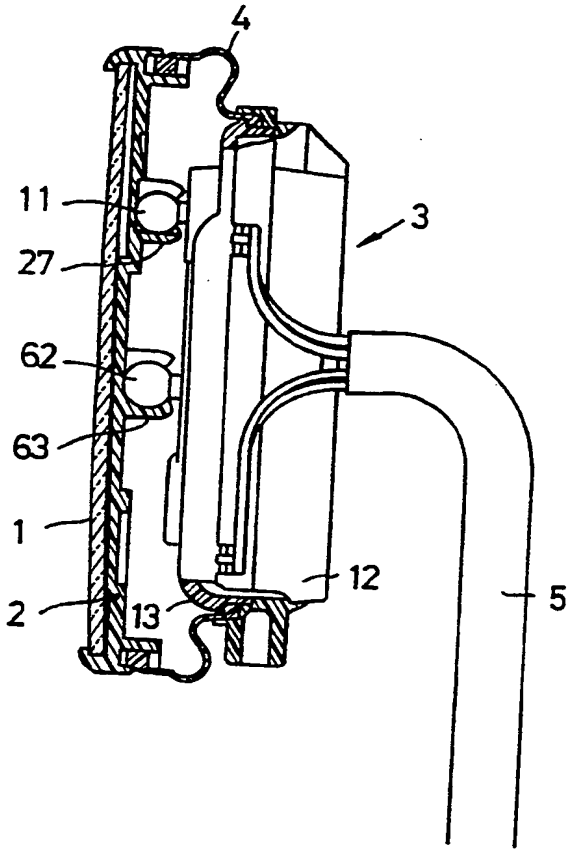


FIG.22

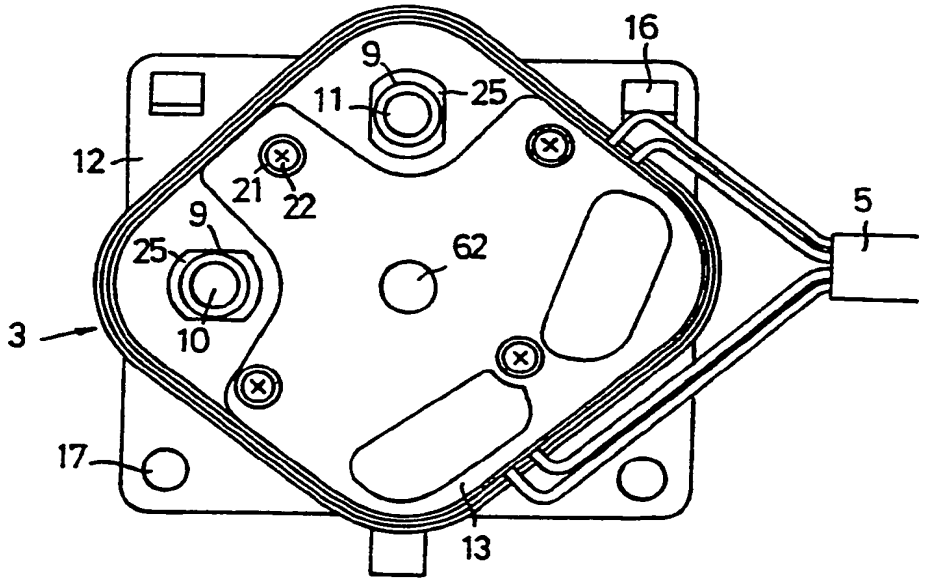
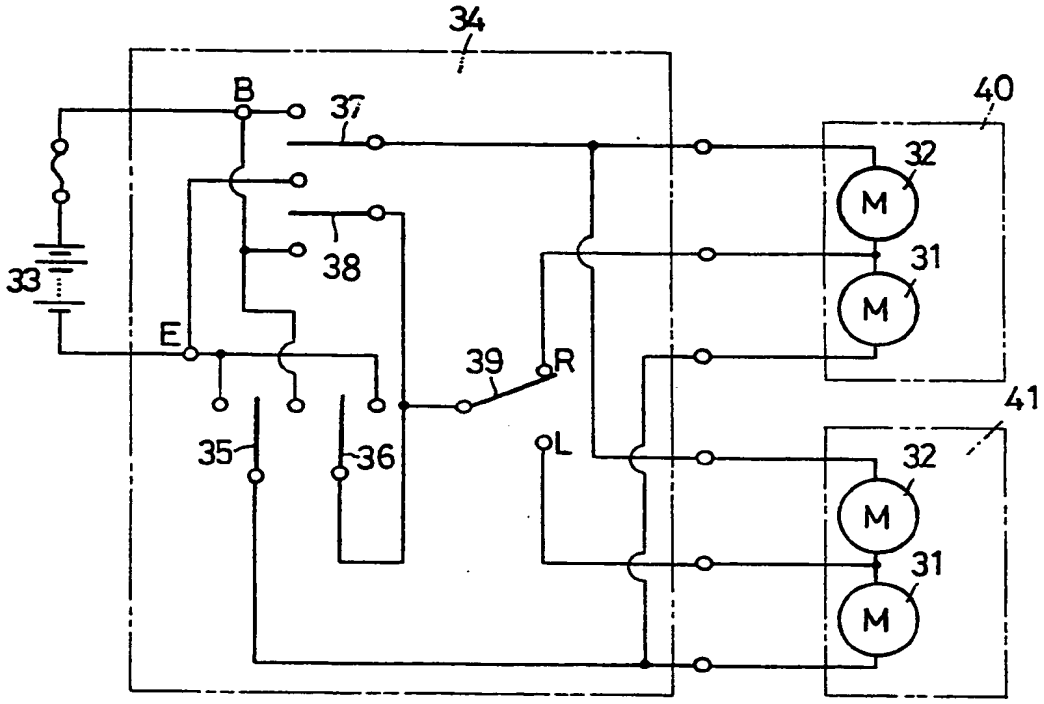


FIG.23



European Patent Office

EUROPEAN SEARCH REPORT

0059073
Application number

EP 82 30 0825.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	DE - A1 - 2 840 789 (P. WEISS) * fig. 1 to 3 *	1,4
X	DE - B2 - 2 456 457 (MÄRKLIN) * claims *	1
A	DE - U - 7 710 876 (HAGUS C. LUCHTEN-BERG) * fig. 3, 5 *	1
A	GB - A - 2 032 367 (MURAKAMI KAIMEIDO CO.) * fig. 14, 15 *	8
A	US - A - 4 056 253 (L.N. REPAY et al.)	
A	US - A - 4 171 873 (L.N. REPAY et al.)	
D,A	US - A - 3 609 014 (A.W. KURZ, JR.)	
D,A	US - A - 3 972 597 (L.N. REPAY et al.)	

CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)

B 60 R 1/06

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

B 60 R 1/00

CATEGORY OF CITED DOCUMENTS

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D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	31-03-1982	BECKER

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